Refined Estimate of the Dominant T Wave

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The Dominant T-wave (DTW) offers an overall view of the repolarization phase in the ventricula. While being only a conceptual entity, it derives directly from an equivalent surface source model (ESSM). Once postulated that the conductive properties of the thorax are linear and that the shape of the repolarization curve of each myocytes is identical, although with different time intervals between firing and repolarization, it can be shown that the T waves of all leads on the thorax are, in first approximation, a scaled version of a single waveform shape.

Generally, the DTW reflects the first-order derivative of the repolarization phase of the transmembrane potential of the myocytes. An increased dispersion of the repolarization times is linked to pathological conditions. In this case the second-order derivative starts to play a relevant role. Unfortunately the method proposed so far only consider the first-order derivative.

In this work we first proposed an algorithm to estimate the DTW taking into account the second-order derivative of the repolarization curve. It is based on the minimization of the Frobenius norm of the residual matrix. This results in a set of non-linear equations and this difficulty is overcame by iteratively solving two linear sub-parts of the system.

The algorithm was tested on synthetic ECG recordings. The shape of the repolarization curve and the scaling factors which accounts for the geometry of the sources were derived from ECGSIM, a freely available software implementing the ESSM. When the dispersion of the sources is varied from 20 to 60 ms, the new technique shows an average improvement in the precision of the estimate of the repolarization curve of about 5.1% over previous methods. This hints that the new method might permit to employ the DTW formalism in a larger set of applicative contexts.